414 Rec'd PCT/PTO 2 3 JUN 2000

FORM PTO-1390 (REV 12-29-99) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE **TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371**		ATTORNEY'S DOCKET NUMBER 010100-101 U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 09/582341
INTERNATIONAL APPLICATION NO. PCT/AU98/01077	INTERNATIONAL FILING DATE December 24, 1998	PRIORITY DATE CLAIMED December 24, 1997

TITLE OF INVENTION
A TRANSMITTER AND A METHOD FOR TRANSMITTING DATA

APPLICANT(S) FOR DO/EO/US
Graham Alexander Munro MURDOCH; Stuart Colin LITTLECHILD

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [X] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [X] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [X] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [X] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [X] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [X] Other items or information:

PCT/IB/308 (copy)
PCT/ISA/210
First Statement of Amendments
Second Statement of Amendments

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U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/582341	PCT/AU98/01077	010100-101

17. ☒ The following fees are submitted:

	CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$970.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$840.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$690.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$670.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$96.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 970.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$ 130.00	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	15 -20 =	0	X $18.00	$	
Independent claims	4 -3 =	1	X $78.00	$ 78.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $260.00	$ 260.00	
TOTAL OF ABOVE CALCULATIONS =				$1438.00	
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also by filed (Note 37 CFR 1.9, 1.27, 1.28).				$	
SUBTOTAL =				$1438.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$1438.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$1438.00	
				Amount to be refunded:	$
				charged:	$

a. ☐ A check in the amount of $1438.00 to cover the above fees is enclosed.
Check No. 1959

b. ☒ Please charge my Deposit Account No. 50-0655 in the amount of $________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☐ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. ________. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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James A. Henricks
NAME

31,168
REGISTRATION NUMBER

Serial Number: Corresponds to PCT/AU98/01077

Atty. Ref. No.: 010100-101

09/582341

PATENT

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CERTIFICATE OF MAILING

I hereby certify that this correspondence and all identified attachments are being deposited on June 23, 2000, with the United States Postal Service as Express Mail, Post Office to Addressee, in an envelope with sufficient postage addressed to:

Box PCT
Assistant Commisioner for Patents
Washington, D C. 20231

By: James A. Henricks, 31,168

TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

In Re Patent Application Of:	**Murdoch et al.**	Examiner:	N/A
Serial Number:	Corresponds to PCT/AU98/01077		
Filed:	June 23, 2000	Group Art Unit:	N/A
Title:	A TRANSMITTER AND A METHOD FOR TRANSMITTING DATA		

Box PCT
Assistant Commissioner for Patents
Washington, D.C. 20231

FIRST PRELIMINARY AMENDMENT

Sir:

<u>In the Specification:</u>

Page 2, please replace the text on page 2 with the following:

— — Additionally, regulations governing the magnitude of electromagnetic emissions place upper limits on the strength of excitation fields that can be used and the allowable bandwidth of an excitation field. The wide bandwidth of the prior art pulse, modulation data results in limitations being placed on the maximum excitation field strength.

DISCLOSURE OF THE INVENTION

It is an object of the invention, at least in the preferred embodiment, to overcome or at least substantially ameliorate one or more of the disadvantages of the prior art.

According to a first aspect of the invention there is provided a method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal having a carrier frequency and sidebands, the sidebands being substantially lower in amplitude than the carrier frequency; and

providing the modulated signal to said first antenna for transmission.

According to a second aspect of the invention there is provided a transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal, the mixing means also providing the modulated signal to the first antenna for transmission, wherein the — —

Page 3, please replace the text on page 3 with the following:

— — modulated signal has a carrier frequency and sidebands, the sidebands being substantially lower in amplitude than the carrier frequency.

Preferably, the modulated signal is received by a second antenna which in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal. Even more preferably, the first signal is used to power the receiver means.

In a preferred form, the modulated signal includes the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal. This form of modulation is described herein as phase jitter modulation (PJM).

In a preferred form the antenna is a tunable coil. Preferably also, both the first and second antennas have a high Q factor.

In a third aspect, there is provided a method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a phase modulation on the carrier signal in accordance with a data signal to create a modulated signal having a carrier and sidebands, the amount of phase modulation being selected such that the amplitude of the sidebands is substantially lower than that of the carrier; and

providing the modulated signal to the first antenna for transmission.

The sidebands are preferably at least 10 dB below the amplitude of the carrier. More preferably, the difference exceeds about 40 dB.

In a fourth aspect, there is provided a transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a phase modulation on the carrier signal in accordance with a data signal to create a modulated signal having a carrier and sidebands, the amount of phase modulation being selected such that the amplitude of the sidebands is substantially lower than that of the carrier, the mixing means also providing the modulated signal to the first antenna for transmission.

Preferably, the sidebands are at least 10 dB below the amplitude of the carrier. More preferably, the difference exceeds about 40 dB.

According to another aspect of the invention there is provided an identification system including a transmitter according to the second or fourth aspects of the invention.

Preferably, the system is for identifying luggage.

BRIEF DESCRIPTION OF THE DRAWINGS

The prior art and a preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic illustration of a prior art transponder circuit;

Figure 2 illustrates representative waveforms associated with the prior art circuit of Figure 1;

Figures 3(a) to 3(c) are frequency spectra associated with the waveforms of the prior art circuit of Figure 1;

Figures 4(a) and 4(b) are phasor diagrams for waveforms produced in accordance with the invention;

Figures 5(a) to 5(c) are frequency spectra associated with the invention;

Page 11, please replace the text on page 11 with the following:

— — filter off the sidebands on the input signal. The output of the schmitt is passed through a chain of invertors designed to add a fixed delay to the input signal. The delay is approximately chosen so that the phase of the output from the delay chain is not 0° or 180° with respect to the LO. A preferred phase value is 90° for circuit convenience. The output of the VCO acts as the LO to demodulate the Phase Jitter Modulated data. The data is demodulated in an exclusive OR gate, the output of which is low pass filtered and detected with a floating comparator.

It will be appreciated that a significant advantage of RIM, especially in RFID tag applications, is the relative case with which it allows high attenuation of sidebands with respect to carrier amplitude. More importantly, this is achieved whilst maintaining relatively high data rates, which is not the case with prior art amplitude modulation schemes.

Although the invention has been described with reference to a specific example it will be appreciated by those skilled in the art that it may be embodied in many other forms.

For example, the sideband amplitude can be 10 dB, 40 dB or even 60 dB down with respect to the carrier. — —

In the claims:

Please cancel claims 2 – 34, without prejudice.

Please add the following new claims:

35. A method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal having a carrier frequency and sidebands, the sidebands being substantially lower in amplitude than the carrier frequency; and

providing the modulated signal to said first antenna for transmission.

36. A method according to claim 35 including the step of receiving the modulated signal with a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

37. A method according to claim 36 wherein the first signal is used to power the receiver means.

38. A method according to claim 36 wherein both the first and second antennas have a high Q factor.

39. A method according to claim 35 including the step of deriving the modulated signal from the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

40. A transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal, the mixing means also providing the modulated signal to the first antenna for transmission, wherein the modulated signal has a carrier frequency and sidebands, the sidebands being substantially lower in amplitude than the carrier frequency.

41. A transmitter according to claim 40 wherein the modulated signal is received by a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

42. A transmitter according to claim 41 wherein the first signal is used to power the receiver means.

43. A transmitter according to claim 40 wherein both the first and second antennas have a high Q factor.

44. A transmitter according to claim 40 wherein the modulated signal includes the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

45. A transmitter according to claim 40 wherein the antenna is a tunable coil.

46. An identification system including a transmitter as defined in claim 40.

47. A system according to claim 48 for identifying luggage.

48. A method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a phase modulation on the carrier signal in accordance with a data signal to create a modulated signal having a carrier and sidebands, the amount of phase modulation being selected such that the amplitude of the sidebands is substantially lower than that of the carrier; and

providing the modulated signal to the first antenna for transmission.

49. A method according to claim 48 wherein the phase modulation is selected such that the sidebands are greater than 10 dB below the carrier amplitude.

50. A method according to claim 49 wherein the phase modulation is selected such that the sidebands are greater than 40 dB below the carrier amplitude.

51. A method according to claim 50 wherein the phase modulation is selected such that the sidebands are greater than 60 dB below the carrier amplitude.

52. A method according to claim 48 including the step of receiving the modulated signal with a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

53. A method according to claim 52 wherein the first signal is used to power the receiver means.

54. A method according to claim 52 wherein both the first and second antennas have a high Q factor.

55. A method according to claims 48 including the step of deriving the modulated signal from the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

56. A transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a phase modulation on the carrier signal in accordance with a data signal to create a modulated signal having a carrier and sidebands, the amount of phase modulation being selected such that the amplitude of the sidebands is substantially lower than that of the carrier, the mixing means also providing the modulated signal to the first antenna for transmission.

57. A transmitter according to claim 56 wherein the phase modulation is selected such that the sidebands are greater than 10 dB below the carrier amplitude.

58. A transmitter according to claim 57 wherein the phase modulation is selected such that the sidebands are greater than 40 dB below the carrier amplitude.

59. A transmitter according to claim 58 wherein the phase modulation is selected such that the sidebands are greater than 60 dB below the carrier amplitude.

60. A transmitter according to claims 56 wherein the modulated signal is received by a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

61. A transmitter according to claim 60 wherein the first signal is used to power the receiver means.

62. A transmitter according to claim 56 wherein both the first and second antennas have a high Q factor.

63. A transmitter according to claim 56 wherein the modulated signal includes the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

64. A transmitter according to claim 56 wherein the antenna is a tunable coil.

65. An identification system including a transmitter according to claim 56.

66. A system according to claim 67, configured for identifying luggage.

67. A transmitter including:

a first antenna;

an oscillator for providing a carrier signal; and

a mixer for imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal, the mixer also providing the modulated signal to the first antenna for transmission, wherein the modulated signal has a carrier frequency and sidebands, the sidebands being substantially lower in amplitude than the carrier frequency.

68. A transmitter including:

a first antenna;

an oscillator for providing a carrier signal; and

a mixer for imposing a phase modulation on the carrier signal in accordance with a data signal to create a modulated signal having a carrier and sidebands, the amount of phase modulation being selected such that the amplitude of the sidebands is substantially lower than that of the carrier, the mixer also providing the modulated signal to the first antenna for transmission.

REMARKS

This application was filed under 35 U.S.C. 371. This National filing is being made after preliminary examination under Chapter II.

The specification and the claims were amended during Chapter II. The amendments to the specification made herein are the same as those made during preliminary examination in Chapter II, and are being requested again in this First Preliminary Amendment to ensure that the amendments were entered during Chapter II.

The claims were also amended during preliminary examination in Chapter II. By this First Preliminary Amendment, Applicants seek to replace those amended claims with the new claims set forth above.

Please consider the claims and the rest of the application in view of the foregoing amendments and remarks. Early notice of allowance of the claims is respectfully requested.

Please charge any additional fee that may be due or credit any overpayment to our deposit Account No. 50-0655. A duplicate copy of this Petition is enclosed.

Respectfully submitted,

Dated: June 23, 2000

James A. Henricks
Registration No. 31,168

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Additionally, regulations governing the magnitude of electromagnetic emissions place upper limits on the strength of excitation fields that can be used and the allowable bandwidth of an excitation field. The wide bandwidth of the prior art pulse, modulation data results in limitations being placed on the maximum excitation field strength.

DISCLOSURE OF THE INVENTION

It is an object of the invention, at least in the preferred embodiment, to overcome or at least substantially ameliorate one or more of the disadvantages of the prior art.

According to a first aspect of the invention there is provided a method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal having a carrier frequency and sidebands, the sidebands being substantially lower in amplitude than the carrier frequency; and

providing the modulated signal to said first antenna for transmission.

According to a second aspect of the invention there is provided a transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal, the mixing means also providing the modulated signal to the first antenna for transmission, wherein the

modulated signal has a carrier frequency and sidebands, the sidebands being substantially lower in amplitude than the carrier frequency.

Preferably, the modulated signal is received by a second antenna which in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal. Even more preferably, the first signal is used to power the receiver means.

In a preferred form, the modulated signal includes the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal. This form of modulation is described herein as phase jitter modulation (PJM).

In a preferred form the antenna is a tunable coil. Preferably also, both the first and second antennas have a high Q factor.

In a third aspect, there is provided a method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a phase modulation on the carrier signal in accordance with a data signal to create a modulated signal having a carrier and sidebands, the amount of phase modulation being selected such that the amplitude of the sidebands is substantially lower than that of the carrier; and

providing the modulated signal to the first antenna for transmission.

The sidebands are preferably at least 10 dB below the amplitude of the carrier. More preferably, the difference exceeds about 40 dB.

In a fourth aspect, there is provided a transmitter including:

a first antenna;

(NEW PAGE)

oscillator means for providing a carrier signal; and

mixing means for imposing a phase modulation on the carrier signal in accordance with a data signal to create a modulated signal having a carrier and sidebands, the amount of phase modulation being selected such that the amplitude of the sidebands is substantially lower than that of the carrier, the mixing means also providing the modulated signal to the first antenna for transmission.

Preferably, the sidebands are at least 10 dB below the amplitude of the carrier. More preferably, the difference exceeds about 40 dB.

According to another aspect of the invention there is provided an identification system including a transmitter according to the second or fourth aspects of the invention.

Preferably, the system is for identifying luggage.

BRIEF DESCRIPTION OF THE DRAWINGS

The prior art and a preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic illustration of a prior art transponder circuit;

Figure 2 illustrates representative waveforms associated with the prior art circuit of Figure 1;

Figures 3(a) to 3(c) are frequency spectra associated with the waveforms of the prior art circuit of Figure 1;

Figures 4(a) and 4(b) are phasor diagrams for waveforms produced in accordance with the invention;

Figures 5(a) to 5(c) are frequency spectra associated with the invention;

Figures 6(a) and 6(b) respectively illustrate methods of encoding and decoding data in accordance with the invention;

Figure 7 is a schematic illustration of a preferred circuit for encoding the data signal for transmission; and

Figure 8 is a schematic illustration of a preferred circuit for decoding the data signal in the transponder.

Detailed Description of a Preferred Embodiment of the Invention

Passive RFID transponders that incorporate a single antenna are interrogated by an interrogator using an excitation field. This field is received by the transponder's antenna and the voltage induced on the antenna is rectified and used to power the transponder. Often it is necessary for the transponder to receive data transmitted from its interrogator. For single antenna transponders the received messages must be received by the same antenna that is used to receive the excitation signal used to power the transponder. In prior art systems the excitation signal is amplitude modulated to convey messages from the interrogator to the transponder.

Figure 1 shows a prior art transponder where the antenna L is tuned by a capacitor C and data is transmitted to the transponder by amplitude modulation. The voltage V1 induced in the transponder's antenna coil is magnified by the antenna's tuning, rectified by the rectifiers and stored on the DC storage capacitor Cdc for use by the transponder's electronic circuits. The antenna voltage is peak level detected by the diode envelope detector D1, C1 and R1 to give the envelope voltage V2.

Figures 2(a) and 2(b) illustrate waveforms associated with the prior art circuit of Figure 1. More particularly, Figure 2(a) shows the excitation voltage V1 with

amplitude intervals to giving pulse position modulation. To deliver the maximum power to the transponder, a low duty cycle is used, typically 10:1. Figure 2(b) shows the envelope of the voltage V2 induced in the antenna. The antenna's transient response results in a finite rise and fall time for V2. The transient time of the antenna must be sufficiently short to allow narrow pulses to pass without significant distortion. The antenna's transient response time constant Ts and bandwidth BW are related by Ts=1/(BW.π). Accordingly, to pass short pulses the bandwidth of the antenna must be broad. For example, to pass 1 μs pulses a bandwidth of at least 1 MHz is required.

Figures 3(a) to 3(c) are frequency spectra associated with the prior art circuit of Figure 1. Figure 3(a) shows a typical data spectrum. For data at 100 kbps the first zero of the frequency spectrum occurs at 100 kHz. Figure 3(b) shows the data spectrum when encoded as pulse position modulation PPM where narrow low duty cycle pulses are used. The spectrum for this type of encoding is much broader than the original data spectrum. For 1 μs pulses with a 10:1 duty cycle the first amplitude zero of the frequency spectrum occurs at 1 MHz. Figure 3(c) shows the spectrum of the excitation signal when modulated with the PPM signal whose spectrum is shown at Figure 3(b). The modulated spectrum is double sided and accordingly, for 1 μs pulses with a 10:1 duty cycle the width of the main spectral lobe is 2 MHz. Clearly the bandwidth of the PPM modulated excitation signal is much broader than the original data spectrum.

To pass the inherently broad band PPM excitation signal both the interrogator and transponder antenna must have a wide bandwidth. Consequently the interrogator and transponder antennae must have a low Q and will operate with a low efficiency. In

the interrogator the generation of 100% amplitude modulated PPM requires that excitation signal be completely quenched for each pulse. This requires a wide band low efficiency antenna. Narrow band antennae would operate with high efficiency but are unable to respond to the narrow amplitude pulses of PPM. Similarly the transponder antenna bandwidth must be broad band enough to pass the modulated excitation signal. Broad band antennae are inherently low Q and are poor collectors of energy from an excitation field.

In this preferred embodiment of the invention data is imposed as a low level signal having a modulated quadrature component. Most preferably this modulation is phase modulation although in other embodiments use is made of amplitude modulation. In the present embodiment the low level signal appears as a tiny phase jitter in the excitation field. There is no change in the amplitude of the excitation field and hence the transmission of power to the transponder is unaffected. This form of modulation will be termed phase jitter modulation or, for convenience, PJM.

There are many methods of producing small modulated phase shifts. For example, by passing the signal through a phase shifter such as an RC or tuned circuit, or through a variable length delay line.

In this embodiment, to produce the signal at the interrogator, a small portion of the excitation signal is phase shifted 90 degrees to give a quadrature signal. This is then PRK modulated with the data signal and added back onto the original excitation signal before being transmitted to the transponder. The resultant signal can be amplitude limited to remove any residual amplitude component. At the transponder these tiny phase shifts in the excitation induce corresponding antenna voltage phase

shifts that are unaltered by any circuit impedances or power regulation circuitry connected to the transponder's antenna.

Figure 4(a) is a phasor diagram of the excitation signal Fc and the modulated quadrature signal PRK. The amplitude of the respective signals are given by their phasor lengths. The phase deviation THETA caused by the modulated quadrature signal is, for low level signals, extremely small and is given by:

THETA = arctan (2xMag(PRK)/Mag(Fc))

For a 40 dB attenuated PRK signal THETA = 1.2 degrees and for a 60 dB attenuated PRK signal THETA = 0.12 degrees. Both of these are extremely small phase deviations of the excitation signal.

Phase quadrature modulation is recovered using a local oscillator (LO) signal, with a fixed phase with respect to the excitation signal, to down convert the modulated data to baseband in a mixer or multiplier. In the transponder the LO signal must be derived from the modulated excitation signal. The preferred method of extracting a LO signal from the modulated excitation signal uses a Phase Locked Loop PLL in the transponder to generate the LO signal. The LO signal is generated by a low loop bandwidth PLL which locks to the original excitation signal's phase but is unable to track the high speed modulated phase shifts. The quadrature data signal is down converted and detected in a mixer or multiplier driven with the LO signal. Depending upon the type of phase detector used in the PLL, and the propagation delays through the circuit, the phase of the LO with respect to the excitation signal can be anywhere between 0° and 360°. If a conventional XOR phase detector is used in the PLL then the output of the PLL oscillator will be at nominally 90 degrees to the excitation signal

and will be in phase with the data modulated phase quadrature signal. A 90° phase between the LO and the excitation signal is not necessary for the effective detection of quadrature phase modulation. An XOR mixer has a linear phase to voltage conversion characteristic from 0° to 180° and 180° to 360°. Hence it gives the same output amplitude irrespective of the phase angle except around 0° and 180° where there is a gain sign change.

The average output voltage DC level from a mixer is a function of the average phase difference between its inputs. It is more convenient for circuit operation for the average output to be around midspan and hence an LO with a phase angle of around 90° is more convenient. The phase of the LO signal can be simply adjusted using fixed phase delay elements. Hence a 0° or 180° phase detector can be used and a further 90° (roughly) of phase shift can be achieved with a fixed delay element.

Figure 4(b) is a phasor diagram of the modulated excitation signal and a quadrature local oscillator signal in the transponder used to demodulate the data signal. The local oscillator signals phase is at 90 degrees with respect to the excitation signal's phase.

For phase modulation the data bandwidth is no broader than the original double sided data bandwidth. When attenuated the level of the modulated data spectrum is extremely low with respect to the excitation signal amplitude making conformance to regulatory emission limits significantly easier than with the prior art.

Figures 5(a) to 5(c) are representative frequency spectra that explain the operation of the invention. More particularly, Figure 5(a) is a typical data spectrum. For data at 100 kbps the first zero of the frequency spectrum occurs at 100 kHz. Figure

5(b) is a representative frequency spectrum of the data when modulated onto a quadrature version of the excitation signal. The spectrum for this type of modulation is the same as the double sided spectrum of the original data spectrum. In the invention the modulated quadrature signal is attenuated and added to the original excitation signal. Figure 5(c) shows the spectrum of the excitation signal Fc plus the attenuated modulated quadrature signal whose spectrum is shown in Figure 5(b). The attenuation level is given by the difference between the amplitude of the excitation signal and the amplitude of the data sidebands.

Since the spectrum of the transmitted excitation signal is equal to the original double sided data spectrum, narrow band high Q interrogator and transponder antennae are used to respectively transmit and receive the modulated excitation signal. Consequently, the interrogator's excitation antenna operates with high efficiency and the transponder's antenna likewise receives energy with high efficiency. In other embodiments use is made of low Q antennae.

Figures 6(a) and 6(b) show methods of modulating and demodulating according to this invention. Turning first to Figure 6(a), the portion of the main excitation signal is phase shifted 90 degrees to produce a quadrature signal. The quadrature signal is then modulated with data. The preferred form of modulation is phase reverse keying PRK. The PRK modulated quadrature signal is attenuated and then added back to the main excitation signal. Although shown in a particular order the sequence phase shift, modulation and attenuation are done in other orders in alternative embodiments. This method of modulation produces low level data side bands on the excitation signal where the sidebands are in phase quadrature to the

excitation signal. The data signal appears as a low amplitude phase jitter on the excitation signal. In some embodiment the signal is further amplitude limited to remove any residual amplitude component.

Figure 6(b) illustrates a method for demodulating the data modulated on to the excitation signal. A LO signal is generated by a low loop bandwidth phase lock loop PLL. The PLL locks on to the excitation signals phase and is unable to follow the high speed phase jitter caused by the data modulation. For the standard PLL phase detector the PLL oscillator will lock at a fixed phase with respect to the excitation signal's phase. This oscillator signal is then used as a LO to demodulate the quadrature sideband data signal in the multiplier. A low pass filter LPF filters out high frequency mixer products and passes the demodulated data signal.

Figure 7 shows an example circuit for encoding the data signal for transmission. An excitation reference source Fc is split through a 90 degree splitter. One output from the splitter is fed to the LO port of a mixer. Data is fed to the mixer's IF port and causes PRK modulation of the LO port's signal. The output of the mixer at the RF port is a PRK modulated quadrature signal. This is attenuated and added back onto the reference by a zero degree combiner ready for transmission to the transponder.

Figure 8 shows an example circuit for decoding the data signal in the transponder. The transponder antenna voltage is squared up by a schmitt trigger, the output of which feeds a type 3 PLL. A type 3 phase detector is a positive edge triggered sequence phase detector which will drive the PLL oscillator to lock at 180° with respect to the input phase. With a low loop bandwidth the PLL is able to easily

filter off the sidebands on the input signal. The output of the schmitt is passed through a chain of invertors designed to add a fixed delay to the input signal. The delay is approximately chosen so that the phase of the output from the delay chain is not 0° or 180° with respect to the LO. A preferred phase value is 90° for circuit convenience. The output of the VCO acts as the LO to demodulate the Phase Jitter Modulated data. The data is demodulated in an exclusive OR gate, the output of which is low pass filtered and detected with a floating comparator.

It will be appreciated that a significant advantage of RIM, especially in RFID tag applications, is the relative case with which it allows high attenuation of sidebands with respect to carrier amplitude. More importantly, this is achieved whilst maintaining relatively high data rates, which is not the case with prior art amplitude modulation schemes.

Although the invention has been described with reference to a specific example it will be appreciated by those skilled in the art that it may be embodied in many other forms.

For example, the sideband amplitude can be 10 dB, 40 dB or even 60 dB down with respect to the carrier.

CLAIMS

1. [AMENDED] A method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal having a carrier frequency and sidebands, the sidebands being substantially lower in amplitude than the carrier frequency; and

providing the modulated signal to said first antenna for transmission.

2. A method according to claim 1 including the step of receiving the modulated signal with a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

3. A method according to claim 2 wherein the first signal is used to power the receiver means.

4. A method according to claim 2 or claim 3 wherein both the first and second antennas have a high Q factor.

5. A method according to claim 1 including the step of deriving the modulated signal from the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

6. [AMENDED] A transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a phase modulation of less than 90° on the carrier signal in accordance with a data signal to create a modulated signal, the mixing means also providing the modulated signal to the first antenna for transmission, wherein the modulated signal has a carrier frequency and sidebands, the sidebands being substantially lower in amplitude than the carrier frequency.

7. A transmitter according to claim 6 wherein the modulated signal is received by a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

8. A transmitter according to claim 7 wherein the first signal is used to power the receiver means.

9. A transmitter according to any one of claim 6 to 8 wherein both the first and second antennas have a high Q factor.

10. A transmitter according to claim 6 wherein the modulated signal includes the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

11. A transmitter according to claim 6 wherein the antenna is a tunable coil.

12. A method for transmitting data from an antenna substantially as herein described with reference to the embodiment of the invention illustrated in the accompanying drawings.

13. A transmitter substantially as herein described with reference to the embodiment of the invention illustrated in the accompanying drawings.

14. An identification system including a transmitter as defined in any one of claims 6 to 11.

15. A system according to claim 14 for identifying luggage.

16. [NEW CLAIM] A method for transmitting data from a first antenna, said method including the steps of:

providing a carrier signal;

imposing a phase modulation on the carrier signal in accordance with a data signal to create a modulated signal having a carrier and sidebands, the amount of phase modulation being selected such that the amplitude of the sidebands is substantially lower than that of the carrier; and

providing the modulated signal to the first antenna for transmission.

17. [NEW CLAIM] A method according to claim 16, wherein the phase modulation is selected such that the sidebands are greater than 10 dB below the carrier amplitude.

18. [NEW CLAIM] A method according to claim 17, wherein the phase modulation is selected such that the sidebands are greater than 40 dB below the carrier amplitude.

19. [NEW CLAIM] A method according to claim 18, wherein the phase modulation is selected such that the sidebands are greater than 60 dB below the carrier amplitude.

20. [NEW CLAIM] A method according to any one of claims 16 to 19 including the step of receiving the modulated signal with a second antenna which, in response thereto, produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

21. [NEW CLAIM] A method according to claim 20 wherein the first signal is used to power the receiver means.

22. [NEW CLAIM] A method according to claim 20 or claim 21 wherein both the first and second antennas have a high Q factor.

23. [NEW CLAIM] A method according to any one of claims 16 to 19 including the step of deriving the modulated signal from the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

24. [NEW CLAIM] A transmitter including:

a first antenna;

oscillator means for providing a carrier signal; and

mixing means for imposing a phase modulation on the carrier signal in accordance with a data signal to create a modulated signal having a carrier and sidebands, the amount of phase modulation being selected such that the amplitude of the sidebands is substantially lower than that of the carrier, the mixing means also providing the modulated signal to the first antenna for transmission.

25. [NEW CLAIM] A transmitter according to claim 24, wherein the phase modulation is selected such that the sidebands are greater than 10 dB below the carrier amplitude.

26. [NEW CLAIM] A transmitter according to claim 25, wherein the phase modulation is selected such that the sidebands are greater than 40 dB below the carrier amplitude.

27. [NEW CLAIM] A transmitter according to claim 26, wherein the phase modulation is selected such that the sidebands are greater than 60 dB below the carrier amplitude.

28. [NEW CLAIM] A transmitter according to any one of claims 24 to 27 wherein the modulated signal is received by a second antenna which, in response thereto,

produces a first signal which is provided to receiver means, the receiver means deriving a second signal indicative of the data signal.

29. [NEW CLAIM] A transmitter according to claim 28 wherein the first signal is used to power the receiver means.

30. [NEW CLAIM] A transmitter according to any one of claims 24 to 29 wherein both the first and second antennas have a high Q factor.

31. [NEW CLAIM] A transmitter according to claims 24 to 27 wherein the modulated signal includes the sum of the carrier signal and an attenuated quadrature carrier signal which is modulated with the data signal.

32. [NEW CLAIM] A transmitter according to any one of claims 24 to 27 wherein the antenna is a tunable coil.

33. [NEW CLAIM] An identification system including a transmitter according to any one of claims 24 to 32.

34. [NEW CLAIM] A system according to claim 33, configured for identifying luggage.

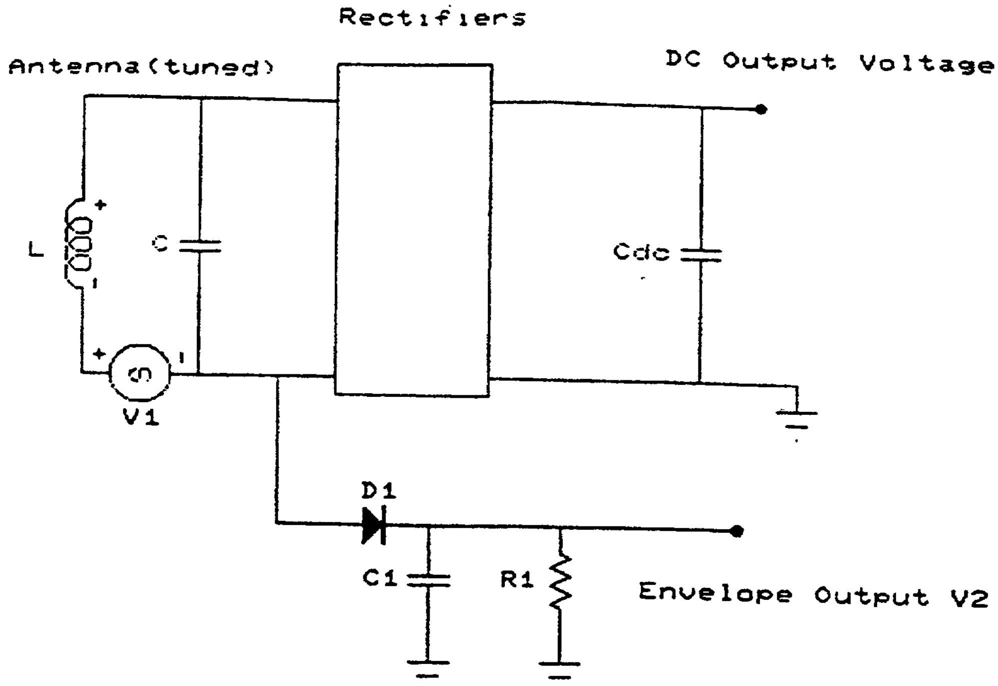

Figure 1 : Prior Art Transponder

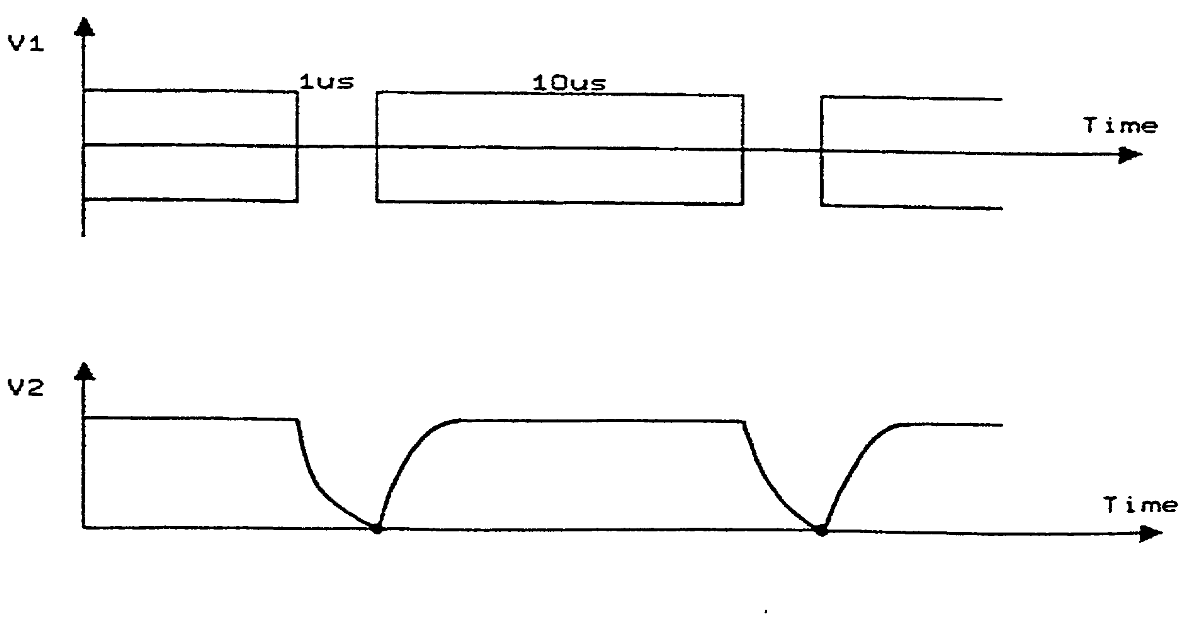

Figure 2 : Excitation V1 and Detected Envelope V2

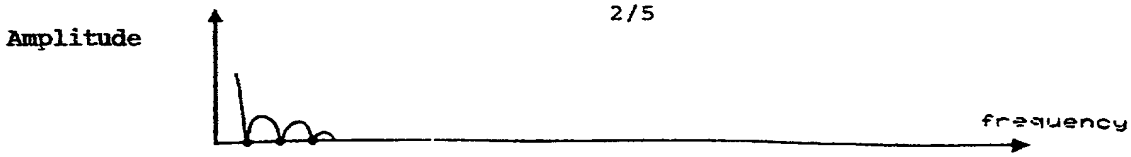

Figure 3(a) : Data Spectrum

Figure 3(b) : Pulse Position Spectrum

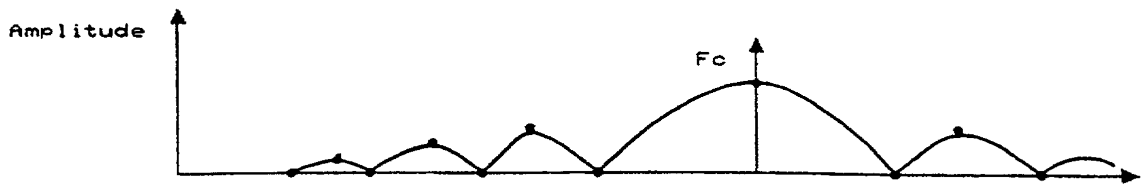

Figure 3(c) · Excitation Spectrum Modulated with PPM frequency

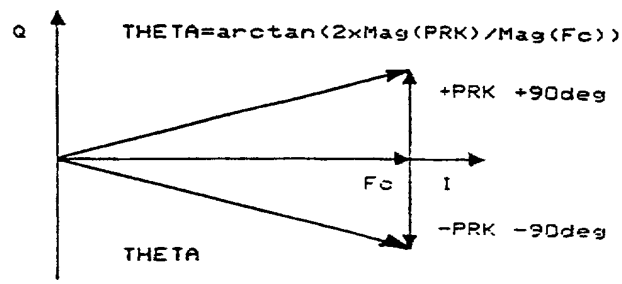

Figure 4(a) : Phasor diagram showing Excitation and Modulation

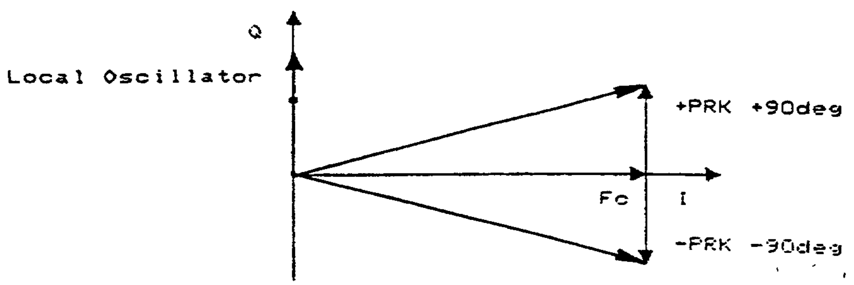

Figure 4(b) : Phasor diagram Showing Local Oscillator at 90deg to Fc

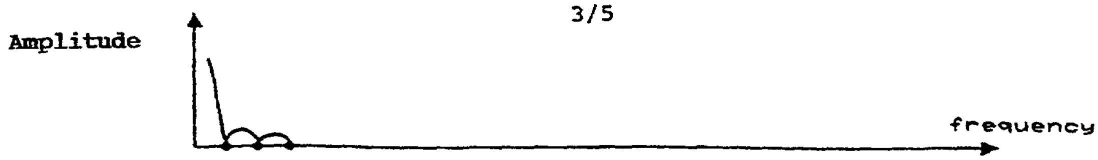

Figure 5(a) : Data Spectrum

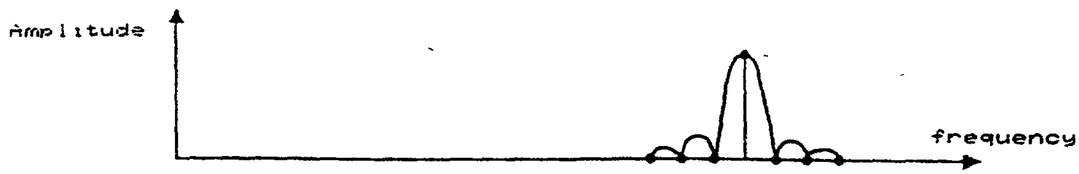

Figure 5(b) : Data Modulated Quadrature Excitation

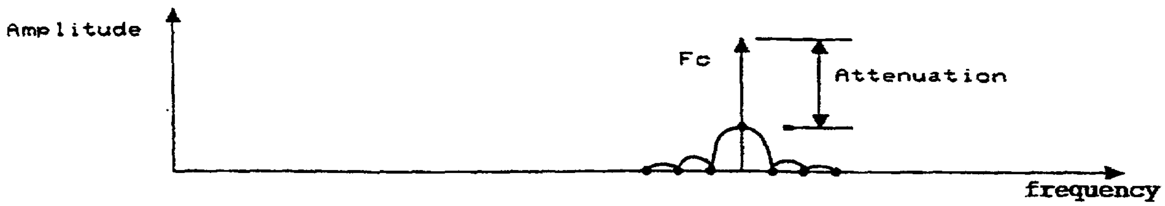

Figure 5(c) : Excitation Spectrum plus Attenuated Quadrature Modulation

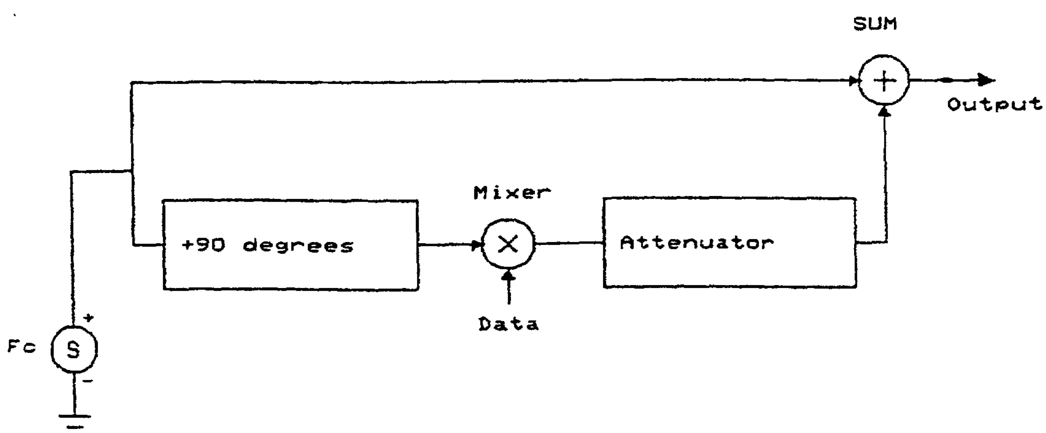

Figure 6(a) : Method of Modulating Excitation Signal

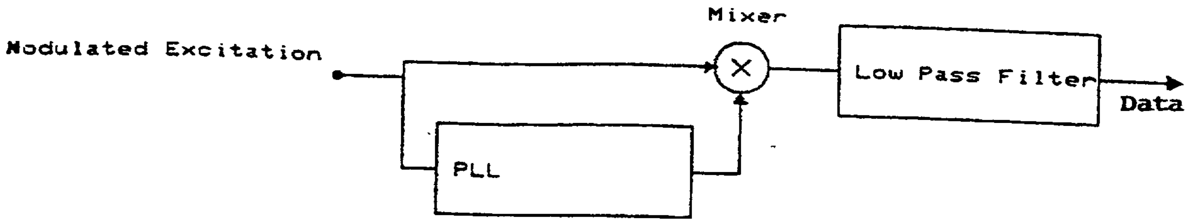

Figure 6(b) : Method of Demodulation

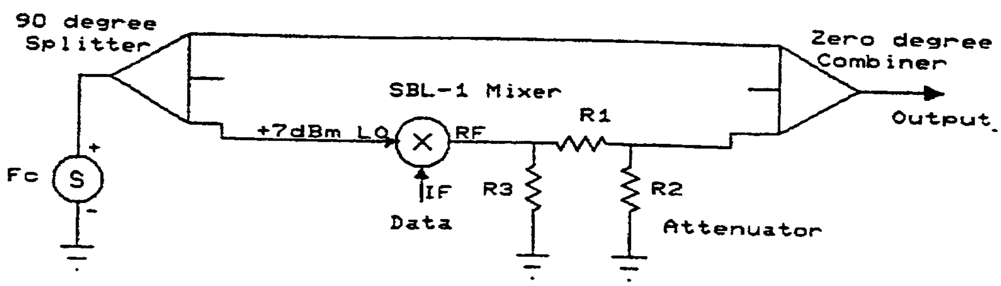

Figure 7 : Example Circuit for Modulating

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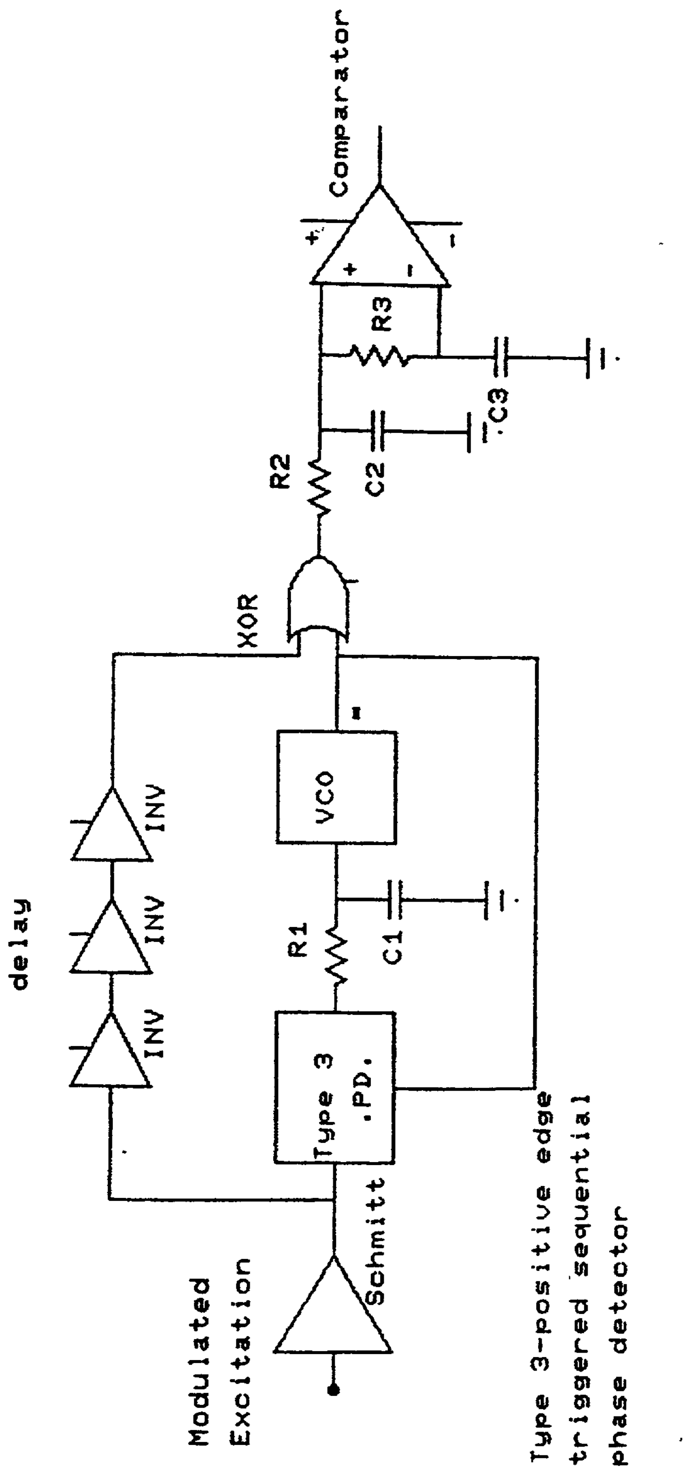

Figure 8 : Example Circuit for Demodulating

PATENT

I certify that on ____________________, which is the date I am signing this certificate, this correspondence and all listed attachments are being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231

____
James A. Henricks

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Patent Application Of:	MURDOCH ET AL.	Examiner:	N/A
Serial Number:	PCT/AU98/01077 & 09/582,341		
Filed:	December 24, 1998	Group Art Unit:	N/A
Title:	A TRANSMITTER AND A METHOD FOR TRANSMITTING DATA		

POWER OF ATTORNEY

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

PARAKAN PTY LTD., ILAMON PTY LTD., AND MAGELLAN TECHNOLOGY PTY LIMITED, having become the owners of all rights in and to the above-identified application by virtue of an Assignment executed, by the inventors concurrently with the execution of the application, said Assignment:

[x] being submitted herewith for recording; or

[ ] having been previously submitted for recordation with the U.S. Patent and Trademark Office, at reel ___ and frame(s)

hereby revokes all prior powers and now appoints:

Customer No. 021836

Namely: J.A. HENRICKS, Reg. 31,168
C.A. SLAVIN, Reg. 35,362
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their attorneys to prosecute said application and to transact in connection therewith all business in the Patent and Trademark Office and before competent International authorities including the World Intellectual Property Organization for all purposes including searching and preliminary examination.

The undersigned, whose title is supplied below, is empowered to act on behalf of the assignee.

I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further, that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: 15 August, 2000

By: Graham Murdoch
Name: GRAHAM MURDOCH
Title: DIRECTOR
Co.: PARAKAN PTY LTD.

Date: 15 AUGUST, 2000

By: S. Litt
Name: STUART LITTLECHILD
Title: DIRECTOR
Co.: ILAMON PTY LTD.

Date: 15 AUGUST, 2000

By: [signature]
Name: ELEANOR SEAN ANGUS
Title: EXECUTIVE DIRECTOR
Co.: MAGELLAN TECHNOLOGY PTY LIMITED

Serial No. 09/582,341
Atty Ref. No. 010100-101

PATENT

Declaration and Petition

(X) Original ( ) Supplemental ( ) Substitute ( ) PCT ( ) Design

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled A TRANSMITTER AND A METHOD FOR TRANSMITTING DATA

(*check one*) [ ] is attached hereto. [XX] was filed on December 24, 1998 as

Application Serial No. 09/582,341 was amended on ____________ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known by me to be material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Application(s) In Other Countries

(Number)	(Country)	Day/month/year filed	Priority claimed Yes	No
PP 1112	Australia	December 24, 1997	XX	
PCT/AU98/01077	WIPO/PCT	December 24, 1998	XX	

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Prior United States Application

(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

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310-563-1460 (fax)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Wherefore I pray that Letters Patent be granted to me for the invention or discovery described and claimed in the foregoing specification and claims, and I hereby subscribe my name to the foregoing specification and claims, declaration, power of attorney, and this petition.

Full name of sole or first inventor **Graham Alexander Munro MURDOCH**
Inventor's signature *Graham Murdoch* Date 15 AUGUST 2000
Residence ~~103 Albion Street, Annandale, New South Wales 2038,~~ AUSTRALIA UNIT 4, 26 GERARD STREET, CREMORNE NEW SOUTH WALES 2090 GM AUX
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Full name of second inventor **Stuart Colin LITTLECHILD**
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